

VINES, VEINS, AND MORNING GLORIES: AN EXAMINATION OF ARBOREAL
PATTERNS IN RELATION TO THE GAIA HYPOTHESIS

CREATIVE PROJECT

SUBMITTED TO THE GRADUATE SCHOOL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE

MASTER OF ARTS

BY

RACHAEL JOBST

BALL STATE UNIVERSITY

MUNCIE, INDIANA

DECEMBER 2009

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BALL STATE UNIVERSITY
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CREATIVE PROJECT ABSTRACT

CREATIVE PROJECT:	Vines, Veins, and Morning Glories
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This project focused on arboreal or branching patterns found in nature. A primary objective was the examination of the Gaia Hypothesis. The Gaia theory is an ecological hypothesis suggesting all systems on earth interact to form a single organism. The Greek word Gaia means earth goddess or spirit of mother earth. Each piece combined metal morning glory vines with bronze castings of the female human figure. The morning glory vines mimic the human circulatory system. Five sculptures culminate this series. The body of work is unified through subject matter and metal-smithing methods. Various metal-smithing techniques were required to produce this creative project including: copper plating and forming, construction, casting, enameling, fold forming, forging, and patination.

TABLE OF CONTENTS

TITLE PAGE	i
FINAL APPROVAL SHEET	ii
ABSTRACT	iii
TABLE OF CONTENTS	iv
CHAPTER ONE: STATEMENT OF PROBLEM	1
CHAPTER TWO: REVIEW OF INFLUENCES	3
CHAPTER THREE: DESCRIPTION OF ARTWORKS AND TECHNICAL PROCESSES	9
CHAPTER FOUR: CONCLUSION	21
CHAPTER FIVE: EXHIBITION STATEMENT	23
WORKS CITED	25
ADDITIONAL READINGS AND ACKNOWLEDGMENTS	28
APPENDIX A: VISUAL EXAMPLES OF ARBOREAL PATTERNS	29
APPENDIX B: BRAIN CELL AND THE UNIVERSE	36
APPENDIX C: EXAMPLES OF GAIA ARTWORKS	37
APPENDIX D: SUPPLIER INFORMATION	39

CHAPTER ONE

STATEMENT OF PROBLEM

The inspiration for this creative project is based on my fascination with the natural world and questions I have asked myself, such as “What is art?” or “How do we define art?” and “What is the meaning of life? How are art and life interrelated?” These are difficult questions that cannot be answered in a lifetime. Through investigation of natural phenomena, I attempt to gather insight into how art and life may be connected.

A component of this series of metalwork is the identification of arboreal patterns found in nature. These tree-like structures range from small to large scale. Branching systems that are prevalent on earth and in the human body specifically intrigue me. The frequency of these arboreal patterns prompts me to consider the Gaia Hypothesis and similarities between the planet and humans. Theme is determined by the depiction of the female human figure, the cardiovascular system, and morning glory vines. Several metal-smithing techniques were utilized in the creation of this project.

My intention is to discuss life by constructing metal sculptures that simulate branching framework. I am motivated to do so by the current ecological crisis of global

warming and overpopulation. The goal of this creative project is to make a statement and raise questions about life by symbolically representing the earth.

CHAPTER TWO

REVIEW OF INFLUENCES

My ideas originate from examination of branching structures. For instance, a tree's trunk splits into large branches; from the large branches, smaller branches stem outward, and so on. I am curious about the continual splitting of a large element into smaller and more numerous parts of the whole.

There are several words that I use to describe these branching structures found in nature, therefore the following terms must be clearly defined: arboreal, dendrite, and fractal. The word arboreal is an adjective that is derived from Latin. The root of the word - arbor - means tree, so arboreal designates a relationship to trees (Merriam-Webster 26). Dendrite also refers to trees. The source term, dendron, has Greek origins and means tree (Merriam-Webster 139). A dendrite may describe the branching projections of a neuron or nerve cell, as well (Jacob 195). The term dendrite is also used to explain some types of crystal growth, which leads to the final term: fractal. Snowflake formation, frost on a window, and galaxy formation display fractal patterns. A fractal is a self-similar object, each part of which repeats itself at a progressively smaller scale (Merriam-Webster 208). Refer to Appendix A for visual examples of arboreal patterns.

Tree-like patterns exist on many scales within the universe. Through the study of natural sciences, humans have discovered that this design continually reoccurs.

Astronomy, biology, chemistry, and earth sciences all describe systems that share these common patterns. Some examples include: trees, root systems, fractals, the cardiovascular system, and lightning, dendrites, vines, snowflakes, and river systems.

Astronomers share my interest with these naturally occurring patterns. Throughout the universe, placement of matter exhibits a fractal configuration. Supercomputers, mathematics, and physics have aided in the production of simulations and images that help illustrate this concept.

The distribution of luminous matter in the Universe is far from homogeneous...

Individual galaxies are tied up into groups and clusters, the latter containing up to hundreds of galaxies. In turn, clusters are often grouped into superclusters, which are among the larger individual structures that have been detected in the Universe.

On the other side of the spectrum, there are large underdense regions, called voids, which display a very low density of luminous objects. (Heck 97)

The universe itself is shaped like a dendrite. “The analysis of the fractal properties of the available galaxy and cluster catalogs has confirmed that the galaxy distribution may be represented as a fractal dust” (Heck 97). The Virgo Consortium for Cosmological Supercomputer Simulations was founded in 1994. Since that time, the Virgo Consortium with its scientific community members from around the world collaborated to produce many amazing images. One of those simulations includes the universe. When compared with an image of neurons, the two appear to be extraordinarily similar. “One is only micrometers wide. The other is billions of light-years across. One

shows neurons in a mouse brain. The other is a simulated image of the universe.

Together they suggest the surprisingly similar patterns found in vastly different natural phenomena” (Constantine). See Appendix B for visual comparison.

Scaling down from the size of the cosmos, evidence of branching patterns can be identified everywhere around the globe. Rivers flow into smaller streams and continue to branch out over the land. The Mississippi River Delta leading into the Gulf of Mexico is a prime example. The flow of water carves the landscape and creates this pattern. In some volcanic eruptions, the flow of lava will travel a dendritic path. Arboreal patterns are also evident in things man-made such as railway systems, roads and interstates, plumbing, electrical wiring, and the exponential growth of the human population.

Decreasing the scale further, these systems of organization are explored at a size more relative to humans. Vegetation displays countless examples of arboreal patterns. Other examples include: subterranean configurations of insect colonies, animal burrows, coral, lightning, and systems in the human body. The circulatory, lymphatic, and nervous systems all have branching characteristics.

Inspirations were also derived from attending “Bodies: The Exhibition” in Indianapolis on October 6, 2008. Witnessing the circulatory system suspended in silicon was visually stunning. Bronchial tubes filled with polymer resin remind one of coral in the ocean reef. Cross-sections of the human brain were also displayed and revealed the branching pattern in the part of the brain called the arbor vitae.

Discovering these common patterns motivate me to compare the human body to the earthly body. There are many similar functions that occur in both that support life, although the earth cannot be defined as an organism capable of reproducing itself. The

atmosphere seems to function as lungs of the Earth. Magma flowing underneath the earth's crust reminds me of blood running through arteries and veins. The earth's surface is made up of about 70% water. The percentage of water in the human body varies from person to person, but is comparable to the water-to-earth ratio. The human body self-regulates its temperature and so does the earth.

Contemplating commonalities between the earth and humans stimulates thoughts about how life is defined. The earth is responsible for supporting life, but is not believed by the majority of the scientific community to be a living organism. However, the Gaian approach has become an increasingly more accepted and viable means to study the natural world.

James Lovelock is responsible for introducing the Gaia Hypothesis. Gaia theory is an ecological hypothesis suggesting all systems on earth interact to form a single living organism. The atmospheric make up of the earth and temperature regulation are central aspects of Lovelock's theory.

The Gaia hypothesis, when introduced in the 1970s, supposed that the atmosphere, the oceans, the climate, and the crust of the Earth are regulated at a state comfortable for life because of the behavior of living organisms.

Specifically, the Gaia hypothesis said that temperature, oxidation state, acidity, and certain aspects of the rocks and waters are at any time kept constant, and that this homeostasis is maintained by active feedback processes operated automatically and unconsciously by the biota. (Lovelock 19)

Lovelock faced some criticism from scientists when he introduced his theory. Lynn Margulis rejects the analogy that Gaia is a single organism because there is no single being that feeds on its own waste, nor, by itself, recycles its own food (Margulis 257). Lynn Margulis, however does agree that in the face of an increased luminosity from the sun, “the Gaia hypothesis recognizes that temperature stability is a property of life on the Earth’s surface” (Margulis 146).

Lovelock later clarifies his original theory. “It is otiose to try to prove that Gaia is alive. Instead, Gaia should be a way to view the Earth, ourselves, and our relationships with living things” (Lovelock 207). “Lovelock tells us that he sees as alive ‘everything that metabolizes and self-regulates...so that life is something shared in common by cats and trees, as well as by beehives, forests, coral reefs and Gaia” (Goldsmith 125). Margulis says, “both scientifically and philosophically, the Gaia hypothesis provides a clear and important theoretical window for what Lovelock calls ‘a new look at life on earth’” (Margulis 146).

The concept of Gaia has also reached the art world. Many artists were brought to my attention through the duration of the creative project. Artists Alex Grey and Frida Kahlo inspired and influenced initially. Both have produced paintings that are representations of Gaia. Their work has also illustrated branching structures and concepts of grand cosmological size scaling down smaller and smaller.

In 1989, Alex Grey painted *Gaia*. The oil painting depicts Gaia as a tree and expresses concerns about the current state of the planet. One side of the tree illustrates a harmonious earth, while the other side represents an industrialized and polluted planet. *Gaia* may be found in Appendix C.

In many of Grey's paintings, there are depictions of branching framework. He paints very detailed images of the human figure. In these paintings, he illustrates the human nervous, cardiovascular, and lymphatic systems. Grey views humans as spiritual beings, so many paintings include a lightening-like pattern that radiates out from the human body. He uses these patterns as a way to attempt to visually describe the life force emitting from humans.

Frida Kahlo illustrates branching patterns and an interpretation of Gaia, as well. Many of her self-portraits exhibit branching or vein-like patterns. There is also a theme running through her work where she uses branching patterns to communicate a connection from one thing to another.

The Love Embrace of the Universe, the Earth (Mexico), Me, Diego and Señor Xólotl shows Kahlo's understanding of Gaian views. The oil painting depicts the sky with a face that embraces a green figure with vegetation from Mexico. The green figure holds Frida who clutches Diego. *The Love Embrace of the Universe, the Earth (Mexico), Me, Diego and Señor Xólotl* is shown in Appendix C.

CHAPTER THREE

DESCRIPTION OF ARTWORKS AND TECHNICAL PROCESSES

Morning glory vines, the cardiovascular system, and fragments of the female human figure are components of the five sculptures. This series of work is intended to be a personification of Gaia. There are a total of seven bronze castings of a woman, which are meant to represent the seven continents of earth.

Extending from the fragments of the figure are veins and arteries that change into morning glory vines. Five different types of morning glories are depicted. Each sculpture is titled after the common name of the morning glory flower that was used. Morning glories are symbolic of man's mortality. Each blossom opens in the day's early light and by night withers and falls from the vine. This is comparable to the amount of time of a human's life relative to the age of the earth's lifespan. There are some species of morning glories that are planted for their appealing blooms. Other species, however, are ripped out of gardens because they choke out other vegetation.

The photographs of the sculptures are sequenced by date of completion, not the order in which they were displayed in the gallery. In the gallery, they were exhibited left to right as follows: *Grandpa Ott*, *Azul Cielo*, *Crimson Rambler*, *Fence Morning Glory*,

and *Heavenly Blue*. This arrangement creates balance between the cool and warm colored morning glory flowers.

Bronze, copper, and enamel were all used in the construction of this series of metalwork. The same techniques were used to fabricate each sculpture, so I will discuss them all together. The description of methods begins with the smallest elements and concludes with the large components of the body of work.

Sixty-four flowers were constructed. The first step in their fabrication began with cutting three-inch circles out of twenty-two gauge copper sheet. Next, three-quarter inch circles were removed from the center of the disks. The outer edges of the circles were hammered to create a slightly ruffled effect.

The disks were given dimension by creating five separate Wedge T-folds, equal distance apart. Wedge T-folds were generated with the aid of a vise. The metal was initially folded over lightly to make a loop. The loop was closed in a vise at an angle and hammered flat leaving a t-shape (Lewton-Brain 89). This technique is comparable to fashioning darts in clothing. Next, the metal was annealed to ensure that it could be unfolded and hammered flat. All of the Wedge T-folds were executed in the same direction. Between the Wedge T-folds, five simple hammered folds were added. The simple folds bent in the opposite direction of the Wedge T-folds. Each flower had the sum of ten folds. The metal was annealed between each fold to keep the copper malleable.

To complete the fabrication of the morning glory flowers, cones were riveted to the disks. Rivets were used as means of connection to ensure that the flowers could later be enameled. Cold connections were required because heated assembly would not have

survived the 1550° F firing temperature necessary to adhere the glass to the metal surface.

Thompson Enamel's liquid flux diluted with water was then painted on the surface of the flowers. While the liquid flux was still wet, enamel was sifted over the flowers. This aided in an evenly distributed base coat of white. At least four firings were essential to complete the coloring of each blossom.

The flowers were attached to the vine with small bolts that were fabricated to mimic the stamen part of the bloom. Approximately two-inch lengths of eighteen-gauge wires were balled up at one end while the opposite end was soldered to small domes. The small domes created the head of the bolts. The under-sides of the domes were soldered to threaded rods. The flowers then were bolted into cast elements that were soldered to the vines.

The cast elements simulated floral bud-like forms that allowed the flowers to naturally link to the vine. These bud forms were originally constructed from sheet metal and four-gauge wire. Roni Castings Inc. made a professional silicon mold of the bud. This ensured that I would be able to produce multiples quickly by injecting molten wax into the mold. By way of the lost-wax casting process, many buds were cast in bronze.

Another technique used was electroplating. The procedure initiated with the collection of morning glory leaves. I found that fresh morning glory leaves cooperated best, although this may not be true for other types of vegetation.

The leaves were then prepared to withstand the highly corrosive plating solution, which contained sulfuric acid and copper sulfate. First, the leaves were coated with Krylon clear acrylic spray in a well-ventilated area. Each leaf had at least three coats

front and back. The morning glory leaves retained their shape better when the clear acrylic was applied to the backside of the leaf first.

Next, sixteen-to-eighteen gauge, annealed copper wire was attached to the sprayed leaves. This was achieved with the use of superglue. Different types of superglue were used. Superglue gel yielded the best results because regular superglue dispersed all over the leaves instead of staying in a concentrated area where it was desired. Adequate time was allowed for the superglue to set.

Electro-conductive paint was applied to one side of the leaves. For safety purposes, this was performed in a ventilated space. It was imperative that the conductive paint made direct contact with the copper wire. This allowed the electrical charge to reach the surface of the leaf. The leaves were dried for five minutes.

The leaves were placed into the plating solution. It was necessary to wear skin and eye protection when the leaves were taken in and out of the solution. A respirator was also used. Then the leaves were fully submerged into the solution. Wire was wrapped tightly around the rod connected to the positive feed of the rectifier. The more tightly the wire was wrapped, the better the electrical connection, and therefore I annealed the copper wires prior to wrapping.

Finally, the power supply was turned on. Low amperage was used to build up the copper slowly. Gradual plating kept the integrity of the leaves' appearance. Too high of amperage would have resulted in a lumpy, inexact surface. The leaves' progress was checked periodically. The amount of time it took to complete the electroplating varied based on the strength of the solution at the given time. When the leaves reached their desired thickness, the power supply was turned off and the leaves were removed from the

solution. The remaining organic material was burned out, which produced completed copper leaves.

After the plating process, the leaves were soaked in baking soda to neutralize the chemicals. The enamel was fused to the surface of the metal in the same manner as the morning glory flowers. I intentionally over-fired some of the leaves. This technique enabled the appearance of the leaves to be realistic in that they were more like imperfect specimens found in nature.

In order to attach the leaves to the vines, I left the lead wires attached. Small copper tubing was soldered to the branching structure. The lead wires were inserted into the tubing. A slight curve was bent, which kept the leaves in place.

Copper tubing, four-gauge and six-gauge wire were used to construct the circulatory system. The wire was tapered and forged into tendrils. To hide solder seams, the fabricated structures were plated and treated with liver of sulfur.

To produce the parts of the body, lost-wax casting was used. The original castings were done in plaster. Wax was then painted into the plaster molds. Sprues were attached to the back of the waxes to form brackets. The sprues later served as hanging devices. The bronzes were finished with Birchwood Casey's antique black patina.

The second-to-last step in the series' construction was the assemblage of the branching structures to the bronze body parts. Wood and bolts were used to execute the connections. The final stage was to manufacture hanging devices that would support the life-sized sculptures. The pieces fasten to the wall with wooden cleats, aluminum plates, and screws.

There were many technical difficulties that had to be worked through with this creative project. Many of these challenges were overcome by using cold connections, such as rivets and bolts. Mimicking nature in metal proved to be extremely demanding.

The development of the morning glory flowers initiated with a variety of prototypes. Charles Lewton-Brain's book, *Foldforming*, was very useful in the evolution of the fabricated morning glory flowers. My first attempts were constructed with the use of solder. The soldered morning glories were time consuming and could not be enameled. Because it was important that the flowers would later be enameled, I had to come up with a solution that could be created multiple times without the use of solder.

The next challenge was to decide how to attach the flowers to the vines. In nature, there is a smooth transition from vine to flower. Multiple bud-like elements were required to achieve the same seamless connection in metal. Consequently, an original had to be fabricated and a mold had to be made.

One of the most difficult problems that had to be overcome was connecting the leaves to the vines. Since the leaves were enameled, they could not be attached with a heated connection. It took a lot of problem solving and many prototypes before I was able to come up with a viable solution. I attempted to use another cast element. A different bud-form was fabricated and a mold was made. This proved to be extremely time consuming, finicky and unsuccessful. The bud-form did not cast well. Many leaves were broken before I utilized small copper tubing as a method of connection. This means of attachment permitted maximum success in an appropriate length of time.

As the series progressed, the problematic step of mounting the sculptures to the wall emerged. *Azul Cielo* and *Crimson Rambler* were the first two sculptures completed

in the series. Their hanging methods were slightly unrefined when compared to *Grandpa Ott*, *Fence Morning Glory*, and *Heavenly Blue*. More sophisticated hanging methods developed, which are explained in the descriptions of each sculpture.

Azul Cielo

Azul Cielo was the first sculpture in the series to be completed. Most of the technical problems were solved as this piece was created. The branching structure was modeled after veins in the human body. I wanted to create a sense of movement in the bronze casting. The female model was instructed to twist her body so that the ribs and hip would protrude, creating more of a rolling landscape. The hanging device was made of wood that bolts onto the bracket on the backside of the casting. A wood cleat was secured to the wall with screws. The sculpture was then hung onto the wall. This installation method was successful, but proved to be awkward to hang the entire assembled piece.

Crimson Rambler



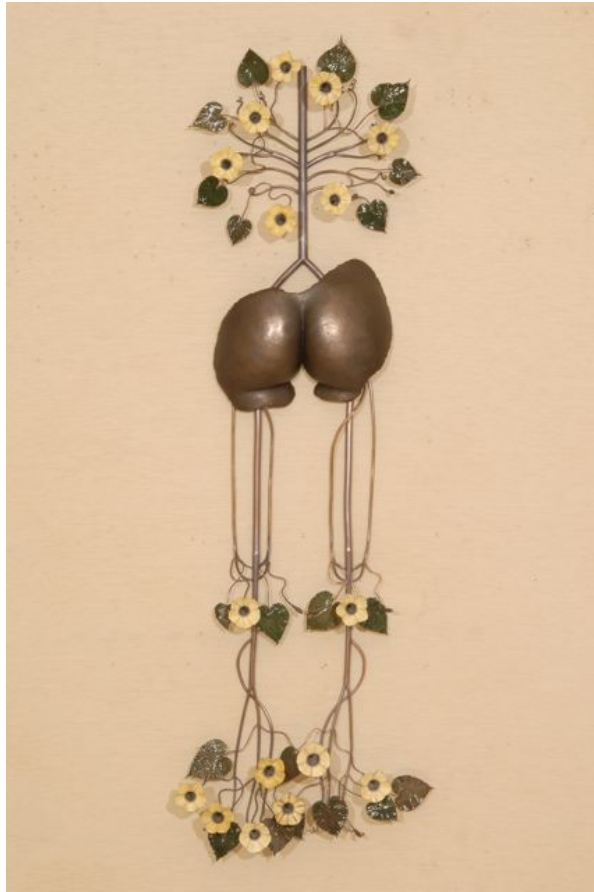
The second piece completed was *Crimson Rambler*. This sculpture followed artery systems in the body. I wanted to create a landscape-like surface with this casting, as well. The model was asked to keep her shoulder blades drawn together as the plaster hardened. The hanging device differs from *Azul Cielo*. *Crimson Rambler's* branching structure attached to the wall before the bronze casting was hung. This made it easier to install. However, the top artery system was hung on the wall separate from the bottom arteries. Due to the artery systems being hung separately, it was difficult to arrange them on the wall without the use of a diagram that showed where the screws go into the wall.

Grandpa Ott



Grandpa Ott was finished third. It was modeled after veins in the body. During the plaster casting of the model's legs, she kept her muscles flexed. This was difficult because it was hard to keep muscles flexed while the plaster set up. *Grandpa Ott* materialized much quicker than *Azul Cielo* and *Crimson Rambler*. I solved installation issues with the first two sculptures. The entire vein structure was attached to the wall first. Then the bronzes were hung on aluminum cleats.

Fence Morning Glory



Fence Morning Glory was the forth sculpture in the series to be fabricated. This piece mimicked artery systems. The construction of this piece went smoothly. All technical issues with hanging devices were solved and it was installed in the same manner as *Grandpa Ott*.

Heavenly Blue

The final sculpture in the series was *Heavenly Blue*. Arteries are used to show the hand, which extended from the bronze arm. This piece was made very quickly. One reason being that it was a third the size of the other works. The other reason was all of the technical problems had been solved and systematic methods of attachment had evolved.

CHAPTER FOUR

CONCLUSION

“The concept of Gaia is entirely linked with the concept of life...no one has yet succeeded in defining life” (Lovelock 16). I will not begin to attempt defining life or the meaning of it. I will say that life is artful in its design. In my considerations of questions like, “What is art?” and “What is the meaning of life?” I have come to the conclusion that while these questions cannot be answered concretely, art and life are inextricable. The two are intertwined. Art is about life. The existence of life is the most extraordinary work of art.

The conceptual purpose of the work is not intended to answer the mysteries of life. Instead, my questions only lead to more questions: “Are humans growing like a weed upon the earth or are they a coexisting flower in bloom?” and “If the earth is a living organism, can the earth sustain the ever-growing human population? At what point does the human race become a ‘choking vine’ onto the world-or-has it already? Will humanity, as a whole, be self aware enough to direct its collective future?”

The human population is growing exponentially and the temperatures on earth are rising due to human activity.

Population growth has slowed down but is still high, and will mean by the year 2050 that the world will have to sustain 50 percent more people than it does today. There has already been severe pressure on natural resources, which will worsen as the new populations demand food and basic living standards. (Overy 344)

Humans are upsetting the temperature regulation of this planet. It is like the earth is running a fever. In the human body, fever is a natural defense mechanism to fight off infection. “Are the earth’s rising temperatures an effort to fight off an infectious species?”

The future of earth is uncertain. However, humans have the consciousness to choose whether they are a parasite that lives in harmony with their host or choke out the very thing they are dependent upon. It would be a tragedy for humans alone to destroy such a masterful work of art that is life on this planet.

CHAPTER FIVE

EXHIBITION STATEMENT

The inspiration for this creative project is based on my fascination with the natural world and various metal-smithing techniques. Casting, electroplating, forging, construction, enameling of fold-forms, and cold connections were all utilized in the creation of these sculptures. Another component of this series of metalwork is the identification of arboreal patterns found in nature. These tree-like structures range from small to large scale. For example: lightning, trees, the circulatory system, brain cells, river systems, and population growth all exhibit this branching pattern.

Branching systems that are prevalent on Earth and in the human body specifically intrigue me. The frequency of these patterns prompts me to consider the Gaia Hypothesis and similarities between the planet and humans. Is earth a living organism that we are all a part of?

The sculptures are intended to personify Gaia. I chose to use morning glory vines to represent humans. This decision was made because some species of morning glories choke out other vegetation while other species are planted in gardens because they can coexist with other species. I am essentially asking if humans are a type of weed upon

the earth. This question is motivated by the current ecological crisis. As population continues to grow and temperatures rise, how much can the world sustain?

I would like to give a special thanks to Pat Nelson. She has been an incredible mentor for me. I am also extremely grateful for my other committee members, Kenton Hall and Chet Geiselman. It has been a pleasure to work with all of you. Thank you! To all of my family and friends, I deeply appreciate your support and love.

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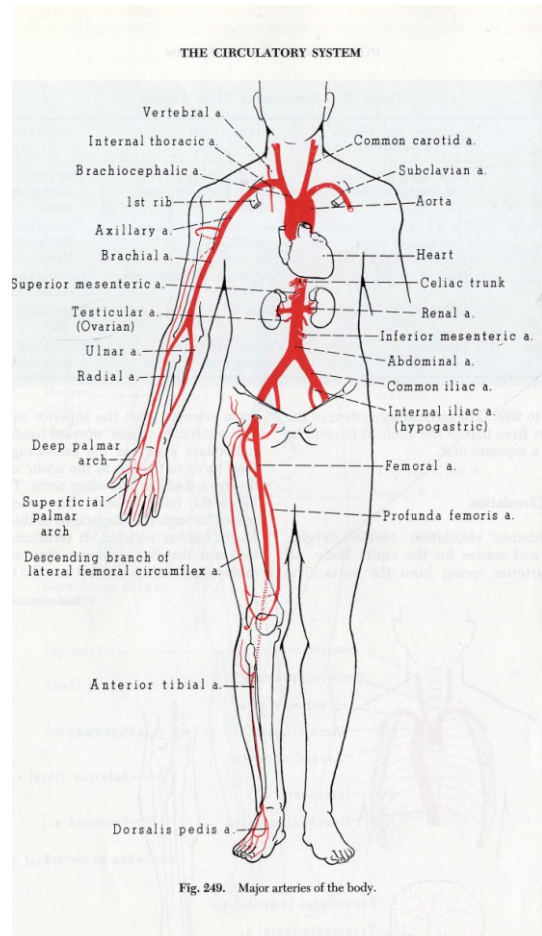
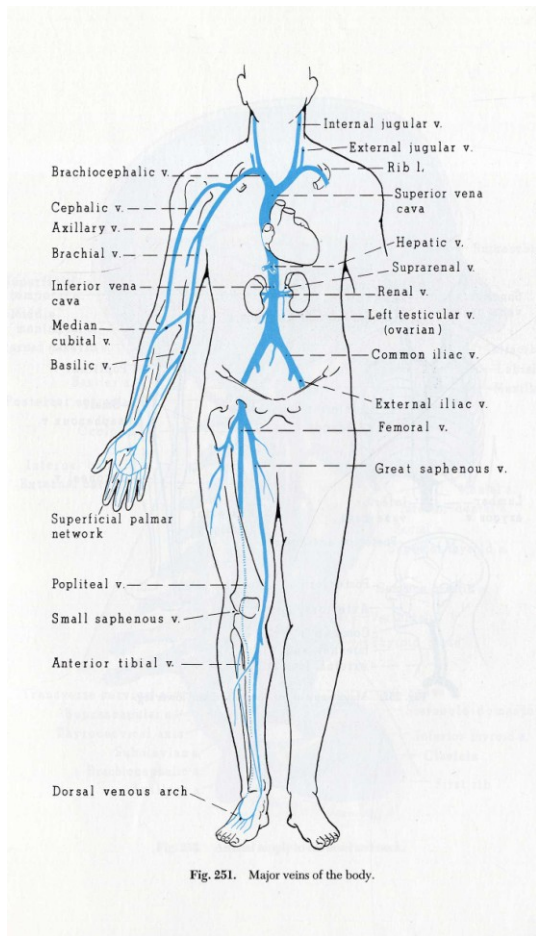
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Tomaselli, Fred. *Fred Tomaselli: Monsters of Paradise*. Edinburgh, Scotland, EH1 1DF: The Friutmarket Gallery, 2004. Print.

APPENDIX A:

VISUAL EXAMPLES OF ARBOREAL PATTERNS



Images source:

Francone, Clarice. "Circulatory System." Drawing. Jacob, Stanley, Clarice

Francone. *Structure and Function in Man*. Philadelphia and London: D.W. Saunders Co., 1965. 305-307. Print.

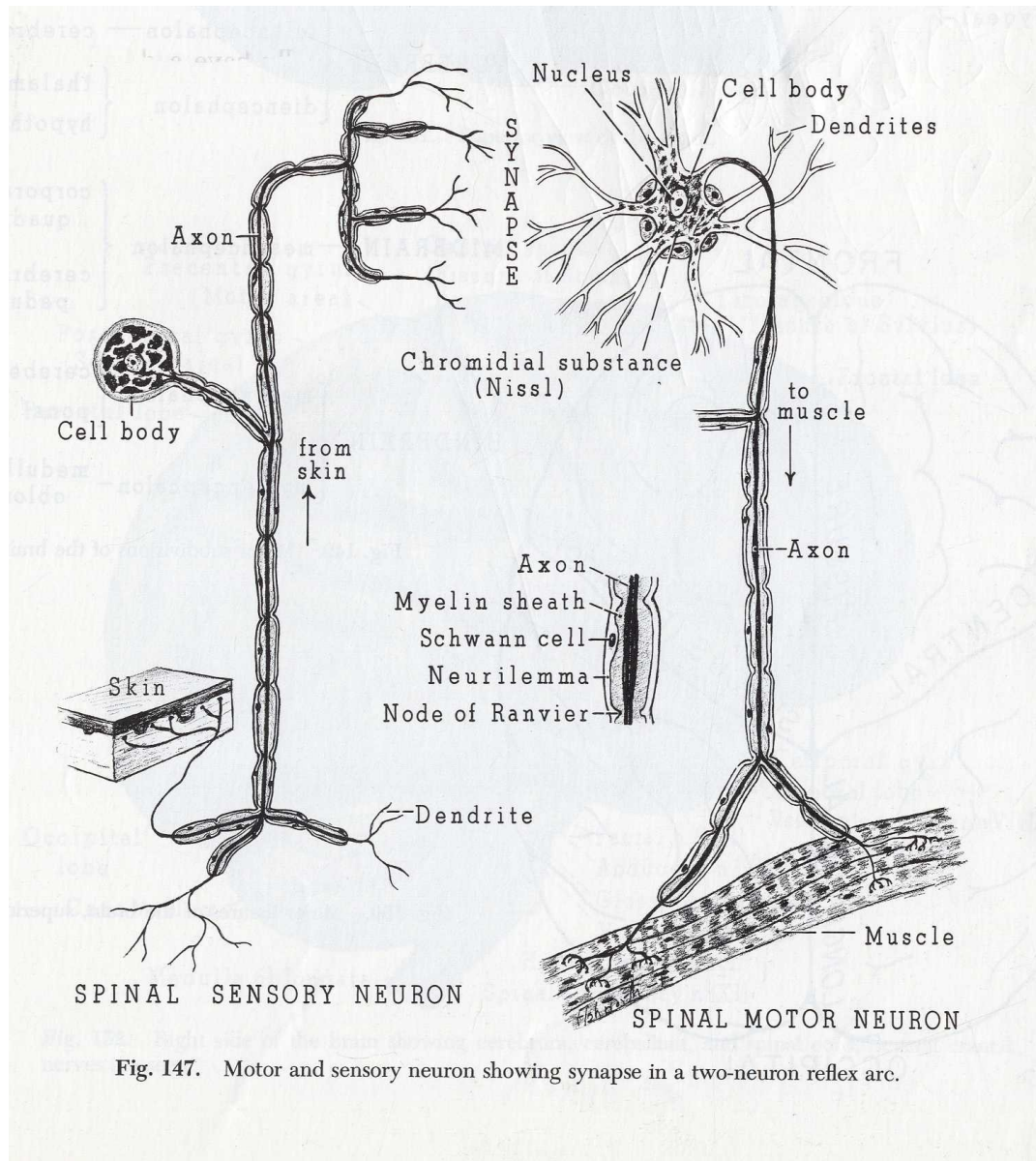


Fig. 147. Motor and sensory neuron showing synapse in a two-neuron reflex arc.

Image source:

Francone, Clarice. "Neurons." Drawing. Jacob, Stanley, Clarice Francone.

Structure and Function in Man. Philadelphia and London: D.W. Saunders Co., 1965.

195. Print.



Image source:

NASA. "Mississippi Birdsfoot Delta." Photograph. Easterbrook, Don J. *Surface Processes and Landforms*. 2nd ed. New Jersey: Prentice-Hall, Inc., 1999, 1993. 102. Print.



Image source:

Hamblin, W.K. "Alluvial Fan: Death Valley." Photograph. Easterbrook, Don J. *Surface Processes and Landforms*. 2nd ed. New Jersey: Prentice-Hall, Inc., 1999, 1993. 102. Print.



Image source:

Holcomby, Robin T. "Volcano." Photograph. *Powers of Nature*. Washington D.C.: National Geographic Society, 1978. 66. Print.



Image source:

Krider, Phil. "Lightning." Photograph. *Powers of Nature*. Washington D.C.: National Geographic Society, 1978. 104. Print.



Image source:

Orville, Richard E. "Lightning Strike." Photograph. *Powers of Nature*.

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Image source:

Schulz, Florian. "Elk." Photograph. *National Parks*. Winter 2007: 22. Print.

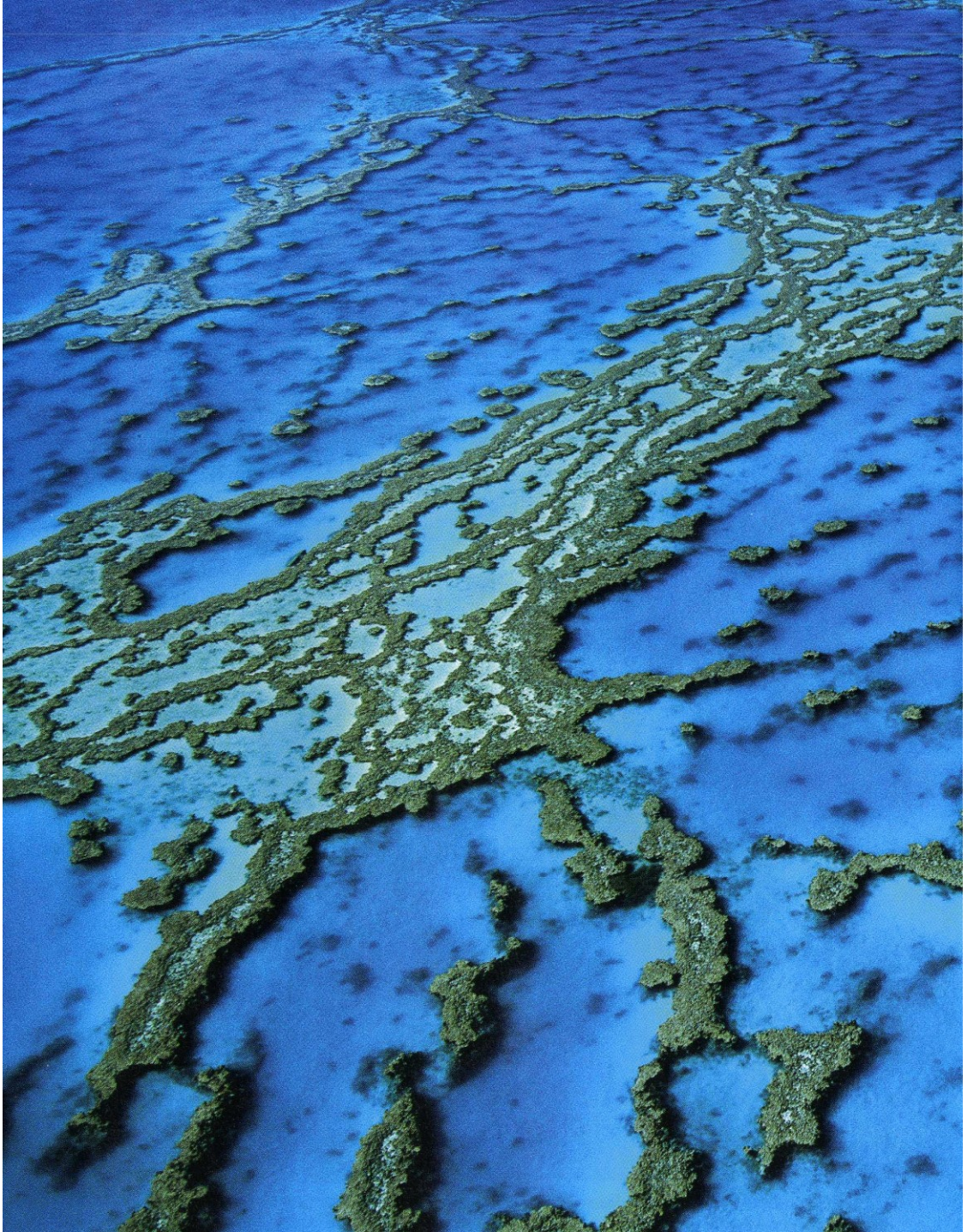


Image source:

Tryner, Jez. "Coral Reef." Photograph. *Conservancy Magazine*. Autumn 2008.

26. Print.



Image source:

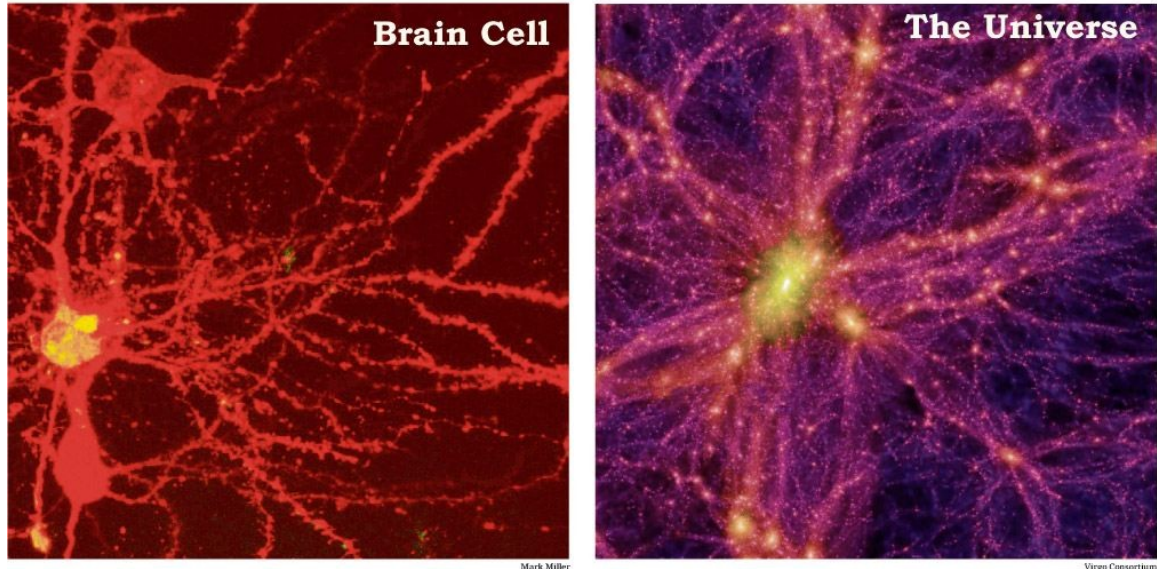
Ferrero, Jean-Paul. "Coral." Photograph. *Conservancy Magazine*. Autumn 2008.

32. Print.

APPENDIX B:

BRAIN CELL AND THE UNIVERSE

One is only micrometers wide. The other is billions of light-years across. One shows neurons in a mouse brain. The other is a simulated image of the universe. Together they suggest the surprisingly similar patterns found in vastly different natural phenomena. DAVID CONSTANTINE



Mark Miller, a doctoral student at Brandeis University, is researching how particular types of neurons in the brain are connected to one another. By staining thin slices of a mouse's brain, he can identify the connections visually. The image above shows three neuron cells on the left (two red and one yellow) and their connections.

Source: Mark Miller, Brandeis University; Virgo Consortium for Cosmological Supercomputer Simulations; www.visualcomplexity.com

An international group of astrophysicists used a computer simulation last year to recreate how the universe grew and evolved. The simulation image above is a snapshot of the present universe that features a large cluster of galaxies (bright yellow) surrounded by thousands of stars, galaxies and dark matter (web).

The New York Times

Images source:

Miller, Mark. "Brain cell." Photograph. Brandeis University.

Visualcomplexity.com n.d. *Sprott.physics.wisc.edu*. Web. 13 Nov. 2009.

Virgo Consortium for Cosmological Supercomputer Simulations. "The Universe."

Simulation. *Virgo.dur.ac.uk*. n.d. *Sprott.physics.wisc.edu*. Web. 13 Nov. 2009.

APPENDIX C:
EXAMPLES OF GAIA ARTWORKS



Gaia, Alex Grey, 1989, oil on linen, 96 x 144 inches.

Image source:

Grey, Alex. *Gaia*. 1989. Chapel of Sacred Mirrors, Wappingers Falls. Grey, Alex. *Sacred Mirrors: The Visionary Art of Alex Grey*. Vermont: Inner Traditions International, 1990. 84-85. Print.



The Love Embrace of the Universe, The Earth (Mexico), Me, Diego and Señor Xólotl,

Frida Kahlo, 1949, oil on canvas, 27 1/2 x 23 7/8 inches.

Image source:

Kahlo, Frida. *The Love Embrace of the Universe, The Earth (Mexico), Me, Diego and Señor Xólotl*. 1949. Private collection, Mexico City. Souter, Gerry. *Frida Kahlo: Beneath the Mirror*. New York: Metro Books, 2005. 117. Print.

APPENDIX D:
SUPPLIER INFORMATION

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508.764.4394

Jimorrisco.com

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New York, NY 10036

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Metalliferous.com

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New York, NY 10036

212.869.1432

Ronicasting.com

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Thompsonenamel.com